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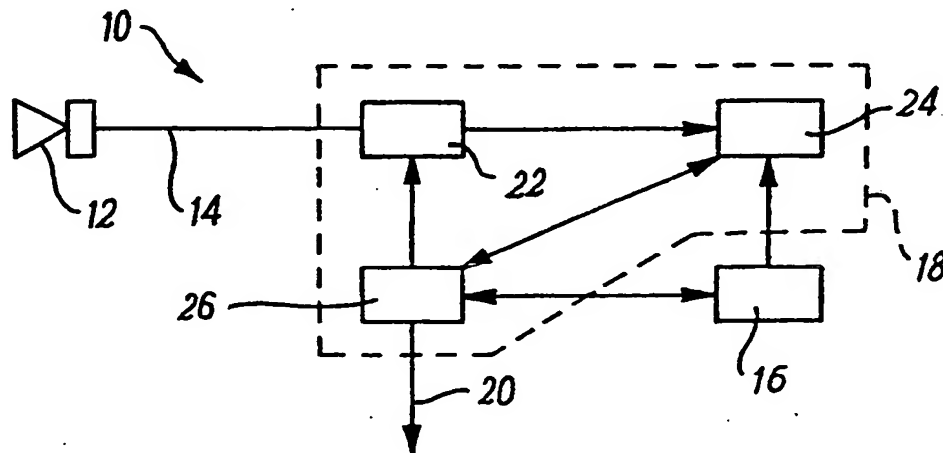
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(54) Title: **ALARM SYSTEM**



(57) Abstract: An alarm system (10) has a transducer (12) in the form of a microphone, to provide a signal at (14) representative of sound in the vicinity of the system (10). A memory (16) stores data related to a predetermined sound, such as a fire alarm. Analysis means (18) can analyse the representative signal (14) and the data stored in the memory (16), to determine when the representative signal represents the predetermined sound, and to provide an alarm signal at (20), in response thereto. This allows, for instance, a deaf person to be alerted to the sound of a fire alarm, by a light actuated by the control circuit (26).

WO 00/74013 A1

### Alarm System

The present invention relates to alarm systems and in particular, but not exclusively, to alarm systems for alerting hearing-impaired or deaf people.

Many public buildings, hotels and the like rely on audible fire alarms to alert occupants to the existence of an emergency situation such as a fire. In hotels, for instance, it is common to provide fire alarm sounders in hotel corridors, stairwells etc. These can be heard in bedrooms by those with normal hearing, but a deaf or hearing-impaired resident cannot respond. A practice has therefore grown up of indicating in the corridor if the occupant of the room needs special assistance in the case of an emergency, such as by hanging a notice from the door handle. This can cause embarrassment to the occupant.

The present invention provides an alarm system comprising transducer means operable to provide a signal representative of sound in the vicinity of the system, memory means operable to store data relating to an audible alarm, and analysis means operable to analyse the representative signal and the stored data to determine when the representative signal represents an audible alarm, and to provide an alarm signal in response thereto.

Preferably the transducer means provides the representative signal in a form which is substantially the same as the form of the stored data, whereby the analysis means may analyse by comparison.

The memory means are preferably operable to store data relating to a predetermined alarm sound. The stored data may comprise a frequency and amplitude profile of the predetermined sound. The stored data may comprise data representing the amplitude or relative amplitudes of the predetermined sound at selected frequencies which are characteristic of the predetermined sound. Alternatively, or in addition, the stored data may comprise data relating to characteristics which an alarm sound is expected to exhibit, whereby at least some sounds not previously encountered by the system can be recognised as

alarm sounds.

Preferably the analysis means comprises filter means operable to filter the representative signal before analysis. The filter means may have one or more passbands substantially only at frequencies which are characteristic of the predetermined sound. The filter means may comprise digital filter means. The analysis means may be operable to set the characteristics of the filter means. The analysis means is preferably operable to set the characteristics in accordance with characteristics stored in the memory means and representative of a predetermined sound.

The analysis means is preferably operable to analyse a signal provided by the transducer means to provide data relating to the sound represented, and to store the provided data in the memory means, whereby the analysis means is able to detect a recurrence of the sound.

The analysis means may provide an alarm signal detectable by a hearing-impaired or deaf person. The alarm signal is preferably a flashing light or vibration.

Embodiments of the present invention will now be described in more detail, by way of example only, and with reference to the accompanying drawings, in which:

Fig. 1 is a schematic block diagram of an alarm system according to the present invention;

Fig. 2 is a frequency and amplitude profile indicating the operation of the system of Fig. 1; and

Fig. 3 represents the filter output for a comparison made by the system of Fig. 1.

Turning to the drawings, Fig. 1 shows an alarm system 10 which comprises transducer means 12 in the form of a microphone operable to provide a signal at 14, representative of sound in the vicinity of the system 10, detected by the microphone 12. A memory 16 stores data related to a predetermined sound, such as a fire alarm. Analysis means 18 is operable to analyse the representative signal 14 and the data stored in the memory 16 to determine when the representative signal 14 represents the predetermined sound, and to provide an alarm signal at 20, in response thereto.

In more detail, the analysis means 18 comprises a filter 22 and a comparison circuit 24 which receives the output of the filter 22 and data from the memory 16 for comparison. The filter 22, comparison circuit 24 and memory 16 are each controlled by a central control circuit 26, preferably in the form of a microprocessor. The functions of the comparison circuit 24 may, in practice, be incorporated into the microprocessor 26, but are described here as a separate component for reasons of clarity of description.

The filter 22 is an active filter, preferably a digital filter whose characteristics can be set by the microprocessor 26. Filter settings for at least one predetermined sound are stored in the memory 16 and are accessible to the microprocessor 26, so that when the system seeks to detect a particular sound, these settings can be retrieved by the microprocessor 26 and used to set the filter 22. The memory 16 also stores data relating to the predetermined sound, for use by the comparison circuit 24, such as the expected output of the filter 22 when set in accordance with the setting data and in the presence of the predetermined sound, as will be described.

Turning to Fig. 2, there are shown highly schematic possible amplitude profiles of sound in the vicinity of the system 10, shown in the frequency domain. Ambient sound may have a profile such as that shown at 28, but it will be apparent that the profile of ambient sound may vary considerably, for instance as between a quiet hotel bedroom, and a bedroom in which a television or radio is playing, traffic noise is coming through an open window, and the

like. A second profile 30 represents the profile of an alarm sounder, such as a fire alarm. These sounders are intended to penetrate ambient sound and be readily heard by those with average hearing. Consequently, the alarm profile 30 has one or more strong peaks 32, the frequencies of which are characteristic of the sounder. The system 10 thus seeks to detect the presence of the alarm sound by looking for the peaks 32 within the sound being detected. This is achieved as follows.

Narrow passbands 34 centred on the peaks 32 can be selected at each peak 32 and can, if desired, incorporate a threshold 36 to further assist in avoiding false triggering. These passbands and thresholds are created by settings of the filter 22, which is preferably a digital active filter, for versatility. Thus, the filter 22 can discard all signals from the signal 14 except those representing sound within the passbands 34 and above the thresholds 36. The output of the filter 22 can therefore be represented diagrammatically as in Fig. 3, showing a narrow spike 38 corresponding to each passband 34. The height of each spike 38 is not relevant, but only its presence. This is because the thresholds 36 ensure that no spike 38 will exist unless the sound exceeds the threshold 36 within the passband 34, which it must do if the alarm sounder is sounding and the threshold 36 has been set just below the peak of the sound provided by the sounder in the corresponding passband 34.

Naturally, one or more passbands 34 could give rise to a spike 38 even if the alarm sounder is not sounding, depending on the profile of other ambient sound. However, it is believed unlikely that every passband 34 would give rise to a spike 38 unless the sounder is sounding. This assumption becomes more strongly valid as the number of characteristic peaks 32 in the alarm profile 30 increases.

In order to complete the analysis, the memory 16 stores details of the expected spike frequencies relating to a predetermined sound, such as the sounder sounding. The comparison circuit 24 can therefore make a simple comparison between the spike frequencies received from the filter 22, and the

expected spike frequencies received from the memory 16. If the filter 22 reports a spike 38 at every spike frequency expected in accordance with the contents of the memory 16, comparison circuit 24 will conclude, on the basis of the assumptions mentioned above, that the alarm sounder is sounding, and report this to the microprocessor 26. The microprocessor can then provide an alarm output at 20, preferably to a flashing light or vibrating device (such as a pillow vibrator). This ensures that the hearing-impaired or deaf user of the system 10 is provided with an alarm signal perceptible to them, in response to the audible alarm signal sounding.

Alternatively, the comparison circuit can also make a comparison of the amplitudes of the spikes, or their relative amplitudes.

The microprocessor 26 allows a number of other operations to be performed, as follows. First, the analysis means 18 can be instructed to listen for a selected one or more predetermined sounds for which related data has been stored in the memory 16. For instance, this could be a selection made by the user. In particular, it is envisaged that the memory 16 could contain data relating to the characteristics of a range of commercially available alarm sounders, particularly fire alarms. A hotel resident can therefore set up the system 10, when first occupying a room, to listen for the particular sounders installed in that hotel. A relatively simple menu-driven operation is envisaged to instruct the system 10 in this way. For instance, the user could inspect the sounder in the hotel corridor, note the manufacturer and type of the sounder, and then select this manufacturer and type from the menu provided on an appropriate display in the system 10. After a selection is made, the microprocessor 26 will retrieve the relevant filter characteristics from the memory 16 to set the filter 12, and instruct the comparison circuit 24 to begin listening. The user can then be confident that the system 10 will listen for operation of that chosen sounder, to alert the user.

Alternatively, the analysis means 18 can operate to listen for the occurrence of any of the predetermined sounds for which data has been stored.

This allows the system to operate automatically, i.e. without the user being required to select any particular predetermined sound.

In a further alternative mode of operation, which may be used, for instance, if the sounders installed in the building are not included within the range of sounds for which data has been stored in the memory 16, the system 10 can be operated to "learn" the characteristics of the sounder. In this mode of operation, the sounder is operated, the sound is detected by the microphone 12 and analysed by the comparison circuit 24 to detect the characteristic peaks 32. The microprocessor 26 can then control the creation of a set of data characteristic of that sounder, for storage in the memory 16, for subsequent use. It may be possible to allow the user to name that data (such as by naming the manufacturer and type of the sounder, or the name of the hotel in which the sounder is installed), so that the user can make use of the data on future occasions. A drawback with this latter mode of operation is that the sounder must be operated, with possible consequences of false alarms with other occupants of the building.

It is particularly advantageous if the memory 16 has sufficient capacity to store data relating to a wide range of conventional, commercially available alarm sounders. This allows the unit to be versatile and allows a hearing-impaired or deaf user to carry the system with them, to be set up whenever they are staying in a building, to provide them with a convenient, discrete and reliable form of alert in the event of alarm sounders operating. Naturally, it is preferred for the system 10 to be battery operated and for the memory 16 to be non-volatile.

Versatility can also be improved by storing in the memory 16 a set of rules which define characteristics which any audible alarm is expected to have, such as volume, duration or the like. The system can then operate by testing a detected sound against these assumptions, rather than by comparing with data relating to predetermined sounds. This increases the likelihood of the system correctly responding to a sound which is an alarm sound, but which has not

previously been encountered by the system.

In an alternative, a system 10 could be provided by the building owner, such as the hotel, as part of the facilities of the hotel room. This system would only be required to respond to the particular sounders in that building.

Many variations and modifications can be made to the apparatus described above, without departing from the scope of the present invention. In particular, many other technologies could be used to implement the system operation described. The examples described above all respond to the amplitude profiles of the sound but it is envisaged that the system could respond to other patterns within the sound, such as a sequence of knocks on a door, or the rhythm of a telephone ring. In the former case, this would allow hotel staff to alert a deaf room occupant, by knocking on the door with a pre-arranged rhythm of knocks. The system could also respond to announcements (such as from a voice synthesiser), by considering the pattern of sound or by interpreting the speech to look for specific text strings.

Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.



### Claims

1. An alarm system comprising transducer means operable to provide a signal representative of sound in the vicinity of the system, memory means operable to store data relating to an audible alarm, and analysis means operable to analyse the representative signal and the stored data to determine when the representative signal represents an audible alarm, and to provide an alarm signal in response thereto.
2. A system according to claim 1, wherein the transducer means provides the representative signal in a form which is substantially the same as the form of the stored data, whereby the analysis means may analyse by comparison.
3. A system according to claim 1 or 2, wherein the memory means are operable to store data relating to a predetermined alarm sound.
4. A system according to claim 3, wherein the stored data comprises a frequency and amplitude profile of the predetermined sound.
5. A system according to claim 4, wherein the stored data comprises data representing the amplitude or relative amplitudes of the predetermined sound at selected frequencies which are characteristic of the predetermined sound.
6. A system according to any preceding claim, wherein the stored data comprises data relating to characteristics which an alarm sound is expected to exhibit, whereby at least some sounds not previously encountered by the system can be recognised as alarm sounds.
7. A system according to any preceding claim, wherein the analysis means comprises filter means operable to filter the representative signal before analysis.
8. A system according to claim 7, wherein the filter means have one or

more passbands substantially only at frequencies which are characteristic of the predetermined sound.

9. A system according to claim 7 or 8, wherein the filter means comprises digital filter means.

10. A system according to any of claims 7 to 9, wherein the analysis means are operable to set the characteristics of the filter means.

11. A system according to claim 10, wherein the analysis means is operable to set the characteristics in accordance with characteristics stored in the memory means and representative of a predetermined sound.

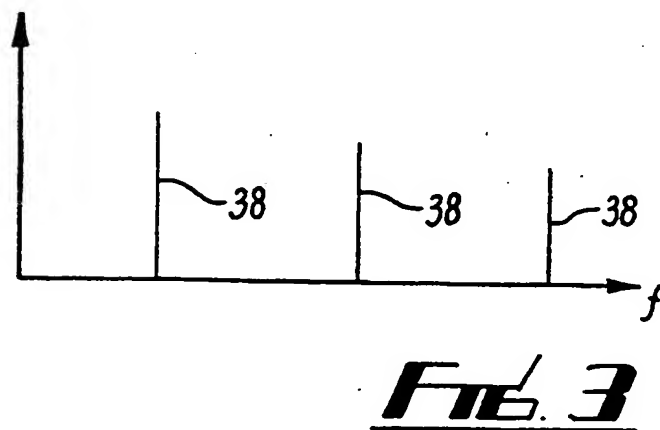
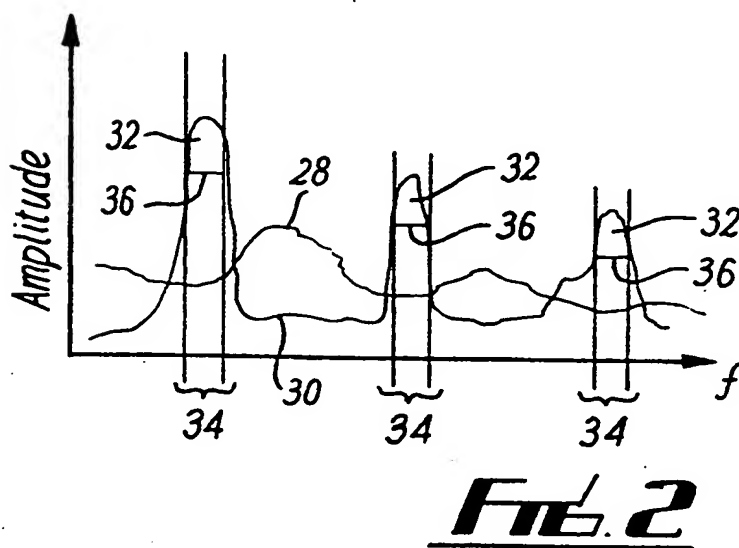
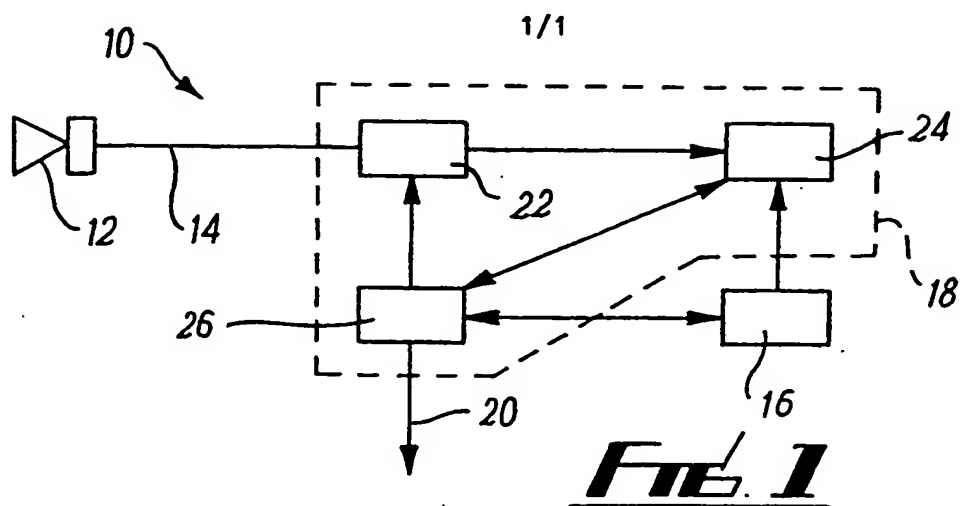
12. A system according to any preceding claim, wherein the analysis means is operable to analyse a signal provided by the transducer means to provide data relating to the sound represented, and to store the provided data in the memory means, whereby the analysis means is able to detect a recurrence of the sound.

13. A system according to any preceding claim, wherein the analysis means is operable to provide an alarm signal detectable by a hearing-impaired or deaf person.

14. A system according to claim 13, wherein the alarm signal is a flashing light or vibration.

15. An alarm system substantially as described above, with reference to the accompanying drawings.

16. Any novel subject matter or combination including novel subject matter disclosed herein, whether or not within the scope of or relating to the same invention as any of the preceding claims.



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/02024

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G08B1/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 34 10 225 A (BEZET WERK HERMANN BUCHHOLZ GM) 19 September 1985 (1985-09-19) the whole document	1-16
A	US 4 759 069 A (BERNSTEIN BERNARD ET AL) 19 July 1988 (1988-07-19) abstract	1-16
A	US 5 745 040 A (LOUGHRIDGE LISA M) 28 April 1998 (1998-04-28) abstract	1-16

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

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US 5745040	A	28-04-1998	NONE	